# CLAIMS

What is claimed is:

1. A method for wireless communication, comprising the steps of:

transmitting a series of transmissions at a predetermined frequency, said transmissions separated by one or more clock intervals pseudo-randomly determined according to an initial code word loaded into a transmitter feedback shift register;

receiving said series of transmissions at a receiver;

at said receiver, measuring relative times of arrival between consecutive ones of said transmissions;

determining said initial code word in the transmitter feedback shift register from the measured relative times of arrival between the consecutive transmissions;

matching a receiver feedback shift register to the initial code word, adjusted by an amount of time since receiving the first one of said consecutive transmissions; and

using said receiver feedback shift register to carry out synchronized communication with the transmitter.

2. The method of claim 1, further comprising the step of transmitting, over a plurality of different frequencies including said predetermined frequency, a series of frequency hopping transmissions during a plurality of frequency hopping intervals, and wherein said step of using said receiver feedback shift register to carry out synchronized communication with the transmitter comprises the step of despreading said frequency hopping transmissions to recover a data signal.

3. The method of claim 1, wherein said step of matching said feedback receiver shift register to the initial code word comprises the steps of

constructing a plurality of relationships between transition matrices, a set of unknown initial states of the transmitter feedback shift register, and information represented by each transition;

deriving a plurality of linear equations from said relationships; and

solving said plurality of linear equations for said set of unknown initial states when the number of linear equations exceeds the number of unknown initial states of the transmitter feedback shift register, thereby yielding the initial states of said transmitter feedback shift register.

4. The method of claim 3, wherein each of said transmissions is generated upon the occurrence of a predetermined set of code values in q designated stages of the transmitter feedback shift register, said transmitter feedback shift register having n total stages, and wherein said step of constructing said plurality of relationships comprises the steps of

(a) assigning, to said q designated stages in the transmitter feedback shift register, said predetermined set of code values upon receipt of a first one of said transmissions;

(b) calculating a number of intervening clock pulses until the next consecutive transmission received at the receiver;

(c) obtaining a time-advanced transition matrix $A^p$ for the current received transmission, wherein an amount of time advancement is based upon a number of

intervening clock pulses p between the occurrence of the first one of said transmissions and the occurrence of the current received transmission;

(d) deriving a linear equation according to the form $x \cdot A^p[q] = y$, wherein x represents a linear vector having a number of elements equal to the number of stages n in said transmitter feedback shift register, said linear vector comprising said predetermined set of code values at locations in said linear vector corresponding to the q designated stages in said transmitter feedback shift register and a set of n-q unknowns at locations in said linear vector corresponding to all other locations in said transmitter feedback shift register, wherein $A^p[q]$ represents a portion of a transition matrix A raised to a power equal to the number of intervening clock pulses p, said portion being those q columns in transition matrix $A^p$ which are associated with said q designated stages in the transmitter feedback shift register, and wherein y represents a linear vector having a number of elements equal to the number of said q designated stages, said elements of y being assigned said predetermined set of code values; and

(e) repeating steps (b) through (d) until a sufficient number of said linear equations are derived to allow said set of unknown initial states to be solved.

5. The method of claim 3, wherein the adjustment of said feedback shift register by said amount of time since the first transmission utilized in said step of measuring relative times of arrival between consecutive transmissions comprises the step of clocking said receiver feedback shift register at an accelerated rate until it matches the transmitter feedback shift register.

6. The method of claim 3, wherein the adjustment of said feedback shift register by said amount of time since the first transmission utilized in said step of measuring relative times of arrival between consecutive transmissions comprises the step of deriving a time-advanced feedback shift register code word by obtaining a plurality of vector dot products between the initial transmitter code word and a plurality of modular feedback shift register code words, said modular feedback shift register code words derived by:

initializing a modular feedback shift register corresponding to the transmitter feedback shift register;

advancing the modular feedback shift register ahead by the number of clock intervals elapsed since the receipt of said first one of said consecutive transmissions, thereby obtaining a first modular feedback shift register code word from the contents of said modular feedback shift register; and

incrementing the modular feedback shift register once for each additional bit needed for the transmitter feedback shift register, thereby obtaining successive modular feedback shift register code words from the contents of said modular feedback shift register at each increment.

7. The method of claim 6, wherein said step of obtaining a plurality of vector dot products between the initial transmitter code word and a plurality of modular feedback shift register code words comprises the step of modulo-two combining one or more selected elements of the initial transmitter code word together to form each bit of

the time-advanced feedback shift register code word, the one or more selected elements of the initial transmitter code word being combined together based upon the code values of said plurality of modular feedback shift register code words.

8. The method of claim 1, further comprising the steps of

transmitting a second series of transmissions at a second predetermined frequency, said transmissions in said second series separated by one or more clock intervals pseudo-randomly determined according to said initial code word loaded into the transmitter feedback shift register;

receiving said second series of transmissions at a second receiver;

at said second receiver, measuring relative times of arrival between consecutive ones of said transmissions in said second series;

determining, at said second receiver, said initial code word in the transmitter feedback shift register from the measured relative times of arrival between the consecutive transmissions in said second series;

matching, at said second receiver, a second receiver feedback shift register to the initial code word, adjusted by an amount of time since receiving the first one of said consecutive transmissions in said second series; and

using said second receiver feedback shift register to carry out synchronized communication with the transmitter and said second receiver.

9. The method of claim 1, wherein each of said transmissions comprises a spread spectrum code, and wherein said step of receiving said series of transmissions at said receiver comprises the step of correlating each of said transmissions using a correlator, said correlator outputting a correlation pulse when each transmission is received, said method further comprising the step of using the correlation pulse to indicate arrival of one of said transmissions.

10. In a frequency hopping spread spectrum communication system, wherein a frequency hopping transmitter transmits in a pseudo-random manner across a plurality of frequencies including a key frequency, the transmissions over said key frequency being separated by one or more clock intervals pseudo-randomly determined according to an initial code word loaded into a transmitter feedback shift register, a method of reception comprising the steps of:

monitoring the key frequency for a series of transmissions by said frequency hopping transmitter;

measuring relative times of arrival between consecutive ones of said transmissions;

determining said initial code word in the transmitter feedback shift register from the measured relative times of arrival between the consecutive transmissions;

matching a receiver feedback shift register to the initial code word, adjusted by an amount of time since receiving the first one of said consecutive transmissions, thereby synchronizing said receiver feedback shift register to the transmitter feedback shift register; and

using said receiver feedback shift register to despread the transmissions of the frequency hopping transmitter over said plurality of frequencies.

11. The method of claim 10, wherein said step of matching said feedback receiver shift register to the initial code word comprises the steps of

constructing a plurality of relationships between transition matrices, a set of unknown initial states of the transmitter feedback shift register, and information represented by each transition;

deriving a plurality of linear equations from said relationships; and

solving said plurality of linear equations for said set of unknown initial states when the number of linear equations exceeds the number of unknown initial states of the transmitter feedback shift register, thereby yielding the initial states of said transmitter feedback shift register.

12. The method of claim 11, wherein each of said transmissions is generated upon the occurrence of a predetermined set of code values in q designated stages of the transmitter feedback shift register, said transmitter feedback shift register having n total stages, and wherein said step of constructing said plurality of relationships comprises the steps of

(a) assigning, to said q designated stages in the transmitter feedback shift register, said predetermined set of code values upon receipt of a first one of said transmissions;

(b) calculating a number of intervening clock pulses until the next consecutive transmission received at the receiver;

(c) obtaining a time-advanced transition matrix $A^p$ for the current received transmission, wherein an amount of time advancement is based upon a number of intervening clock pulses p between the occurrence of the first one of said transmissions and the occurrence of the current received transmission;

(d) deriving a linear equation according to the form $x \cdot A^p[q] = y$, wherein x represents a linear vector having a number of elements equal to the number of stages n in said transmitter feedback shift register, said linear vector comprising said predetermined set of code values at locations in said linear vector corresponding to the q designated stages in said transmitter feedback shift register and a set of n-q unknowns at locations in said linear vector corresponding to all other locations in said transmitter feedback shift register, wherein $A^p[q]$ represents a portion of a transition matrix A raised to a power equal to the number of intervening clock pulses p, said portion being those q columns in transition matrix $A^p$ which are associated with said q designated stages in the transmitter feedback shift register, and wherein y represents a linear vector having a number of elements equal to the number of said q designated stages, said elements of y being assigned said predetermined set of code values; and

(e) repeating steps (b) through (d) until a sufficient number of said linear equations are derived to allow said set of unknown initial states to be solved.

13. The method of claim 10, wherein the adjustment of said feedback shift register by said amount of time since the first transmission utilized in said step of measuring relative times of arrival between consecutive transmissions comprises the step of clocking said receiver feedback shift register at an accelerated rate until it matches the transmitter feedback shift register.

14. The method of claim 10, wherein the adjustment of said feedback shift register by said amount of time since the first transmission utilized in said step of measuring relative times of arrival between consecutive transmissions comprises the step of deriving a time-advanced feedback shift register code word by obtaining a plurality of vector dot products between the initial transmitter code word and a plurality of modular feedback shift register code words, said modular feedback shift register code words derived by:

initializing a modular feedback shift register corresponding to the transmitter feedback shift register;

advancing the modular feedback shift register ahead by the number of clock intervals elapsed since the receipt of said first one of said consecutive transmissions, thereby obtaining a first modular feedback shift register code word from the contents of said modular feedback shift register; and

incrementing the modular feedback shift register once for each additional bit needed for the transmitter feedback shift register, thereby obtaining successive modular feedback shift register code words from the contents of said modular feedback shift register at each increment.

15. In a direct sequence spread spectrum communication system, wherein a direct sequence spread spectrum transmitter transmits in a pseudo-random manner over a predetermined frequency, the transmissions over said predetermined frequency being separated by one or more clock intervals pseudo-randomly determined according to an initial code word loaded into a transmitter feedback shift register, a method of reception comprising the steps of:

monitoring the predetermined frequency for a series of transmissions by said direct sequence spread spectrum transmitter;

measuring relative times of arrival between consecutive ones of said transmissions;

determining said initial code word in the transmitter feedback shift register from the measured relative times of arrival between the consecutive transmissions;

matching a receiver feedback shift register to the initial code word, adjusted by an amount of time since receiving the first one of said consecutive transmissions, thereby synchronizing said receiver feedback shift register to the transmitter feedback shift register; and

using said receiver feedback shift register to despread the transmissions of the direct sequence spread spectrum transmitter over said plurality of frequencies.

16. The method of claim 15, wherein said step of matching said feedback receiver shift register to the initial code word comprises the steps of

constructing a plurality of relationships between transition matrices, a set of unknown initial states of the transmitter feedback shift register, and information represented by each transition;

deriving a plurality of linear equations from said relationships; and

solving said plurality of linear equations for said set of unknown initial states when the number of linear equations exceeds the number of unknown initial states of the transmitter feedback shift register, thereby yielding the initial states of said transmitter feedback shift register.

17. The method of claim 16, wherein each of said transmissions is generated upon the occurrence of a predetermined set of code values in q designated stages of the transmitter feedback shift register, said transmitter feedback shift register having n total stages, and wherein said step of constructing said plurality of relationships comprises the steps of

(a) assigning, to said q designated stages in the transmitter feedback shift register, said predetermined set of code values upon receipt of a first one of said transmissions;

(b) calculating a number of intervening clock pulses until the next consecutive transmission received at the receiver;

(c) obtaining a time-advanced transition matrix $A^p$ for the current received transmission, wherein an amount of time advancement is based upon a number of intervening clock pulses p between the occurrence of the first one of said transmissions and the occurrence of the current received transmission;

(d) deriving a linear equation according to the form $x \cdot A^p[q] = y$, wherein x represents a linear vector having a number of elements equal to the number of stages n in said transmitter feedback shift register, said linear vector comprising said predetermined set of code values at locations in said linear vector corresponding to the q designated stages in said transmitter feedback shift register and a set of n-q unknowns at locations in said linear vector corresponding to all other locations in said transmitter feedback shift register, wherein $A^p[q]$ represents a portion of a transition matrix A raised to a power equal to the number of intervening clock pulses p, said portion being those q columns in transition matrix $A^p$ which are associated with said q designated stages in the transmitter feedback shift register, and wherein y represents a linear vector having a number of elements equal to the number of said q designated stages, said elements of y being assigned said predetermined set of code values; and

(e) repeating steps (b) through (d) until a sufficient number of said linear equations are derived to allow said set of unknown initial states to be solved.

18. The method of claim 15, wherein the adjustment of said feedback shift register by said amount of time since the first transmission utilized in said step of measuring relative times of arrival between consecutive transmissions comprises the step of clocking said receiver feedback shift register at an accelerated rate until it matches the transmitter feedback shift register.

19. The method of claim 15, wherein the adjustment of said feedback shift register by said amount of time since the first transmission utilized in said step of measuring relative times of arrival between consecutive transmissions comprises the step of deriving a time-advanced feedback shift register code word by obtaining a plurality of vector dot products between the initial transmitter code word and a plurality of modular feedback shift register code words, said modular feedback shift register code words derived by:

initializing a modular feedback shift register corresponding to the transmitter feedback shift register;

advancing the modular feedback shift register ahead by the number of clock intervals elapsed since the receipt of said first one of said consecutive transmissions, thereby obtaining a first modular feedback shift register code word from the contents of said modular feedback shift register; and

incrementing the modular feedback shift register once for each additional bit needed for the transmitter feedback shift register, thereby obtaining successive modular feedback shift register code words from the contents of said modular feedback shift register at each increment.

20. A method for broadcasting wireless signals to selected receivers, the method comprising the steps of:

transmitting a series of frequency-hopped transmissions over a plurality of frequencies including one or more key frequencies, the transmissions on a key

frequency separated by one or more clock intervals pseudo-randomly determined according to an initial code word loaded into a transmitter feedback shift register; and

separately at each of a plurality of receivers:

monitoring a designated one of said key frequencies;

measuring relative times of arrival between consecutive ones of said transmissions on the receiver's designated key frequency;

determining said initial code word in the transmitter feedback shift register from the measured relative times of arrival between the consecutive transmissions on the receiver's designated key frequency;

matching a receiver feedback shift register to the initial code word, adjusted by an amount of time since receiving the first one of said consecutive transmissions on the receiver's designated key frequency; and

using said receiver feedback shift register to carry out synchronized communication with the transmitter.

21. The method of claim 20, wherein said step of transmitting said series of frequency-hopped transmissions over said plurality of frequencies including one or more key frequencies comprises the step of omitting transmissions on a key frequency to prevent a receiver which is tuned to that key frequency from synchronizing to the transmitter.

22. The method of claim 20, wherein said step of using said receiver feedback shift register to carry out synchronized communication with the transmitter comprises the step of despreading said frequency-hopped transmissions to recover a data signal.

23. The method of claim 20, wherein said step of matching said feedback receiver shift register to the initial code word comprises the steps of

constructing a plurality of relationships between transition matrices, a set of unknown initial states of the transmitter feedback shift register, and information represented by each transition;

deriving a plurality of linear equations from said relationships; and

solving said plurality of linear equations for said set of unknown initial states when the number of linear equations exceeds the number of unknown initial states of the transmitter feedback shift register, thereby yielding the initial states of said transmitter feedback shift register.

24. The method of claim 23, wherein each of the transmissions on a particular key frequency is generated upon the occurrence of a predetermined set of code values in q designated stages of the transmitter feedback shift register, said transmitter feedback shift register having n total stages, and wherein said step of constructing said plurality of relationships comprises the steps of

(a) assigning, to said q designated stages in the transmitter feedback shift register, said predetermined set of code values upon receipt of a first one of said transmissions on the receiver's designated key frequency;

(b) calculating a number of intervening clock pulses until the next consecutive transmission on the receiver's designated key frequency that is received at the receiver;

(c) obtaining a time-advanced transition matrix $A^p$ for the current received transmission on the receiver's designated key frequency, wherein an amount of time advancement is based upon a number of intervening clock pulses p between the occurrence of the first one of said transmissions on the receiver's designated key frequency and the occurrence of the current received transmission on the receiver's designated key frequency;

(d) deriving a linear equation according to the form $x \cdot A^p[q] = y$, wherein x represents a linear vector having a number of elements equal to the number of stages n in said transmitter feedback shift register, said linear vector comprising said predetermined set of code values at locations in said linear vector corresponding to the q designated stages in said transmitter feedback shift register and a set of n-q unknowns at locations in said linear vector corresponding to all other locations in said transmitter feedback shift register, wherein $A^p[q]$ represents a portion of a transition matrix A raised to a power equal to the number of intervening clock pulses p, said portion being those q columns in transition matrix $A^p$ which are associated with said q designated stages in the transmitter feedback shift register, and wherein y represents a linear vector having a number of elements equal to the number of said q designated stages, said elements of y being assigned said predetermined set of code values; and

(e) repeating steps (b) through (d) until a sufficient number of said linear equations are derived to allow said set of unknown initial states to be solved.

25. The method of claim 23, wherein the adjustment of said feedback shift register by said amount of time since the first transmission utilized in said step of measuring relative times of arrival between consecutive transmissions on the receiver's designated key frequency comprises the step of clocking said receiver feedback shift register at an accelerated rate until it matches the transmitter feedback shift register.

26. The method of claim 23, wherein the adjustment of said feedback shift register by said amount of time since the first transmission utilized in said step of measuring relative times of arrival between consecutive transmissions on the receiver's designated key frequency comprises the step of deriving a time-advanced feedback shift register code word by obtaining a plurality of vector dot products between the initial transmitter code word and a plurality of modular feedback shift register code words, said modular feedback shift register code words derived by:

initializing a modular feedback shift register corresponding to the transmitter feedback shift register;

advancing the modular feedback shift register ahead by the number of clock intervals elapsed since the receipt of said first one of said consecutive transmissions on the receiver's designated key frequency, thereby obtaining a first modular feedback shift register code word from the contents of said modular feedback shift register; and

incrementing the modular feedback shift register once for each additional bit needed for the transmitter feedback shift register, thereby obtaining successive modular feedback shift register code words from the contents of said modular feedback shift register at each increment.

27. The method of claim 26, wherein said step of obtaining a plurality of vector dot products between the initial transmitter code word and a plurality of modular feedback shift register code words comprises the step of modulo-two combining one or more selected elements of the initial transmitter code word together to form each bit of the time-advanced feedback shift register code word, the one or more selected elements of the initial transmitter code word being combined together based upon the code values of said plurality of modular feedback shift register code words.

28. A wireless communication system, comprising:

a spread spectrum transmitter configured to transmit a series of transmissions at a predetermined frequency, said transmissions separated by one or more clock intervals pseudo-randomly determined according to an initial code word loaded into a transmitter feedback shift register; and

a receiver comprising circuitry for receiving and synchronizing to said series of transmissions, said receiver comprising

a receiver feedback shift register;

means for measuring relative times of arrival between consecutive ones of said transmissions;

a synchronizing circuit for determining said initial code word in the transmitter feedback shift register from the measured relative times of arrival between the consecutive transmissions, and matching said receiver feedback shift register to the initial code word, adjusted by an amount of time since receiving the first one of said consecutive transmissions.

29. The wireless communication system of claim 28, wherein said spread spectrum transmitter transmits, over a plurality of different frequencies including said predetermined frequency, a series of frequency hopping transmissions during a plurality of frequency hopping intervals, and

wherein said receiver feedback shift register is used for carrying out synchronized communication with the transmitter by despreading said frequency hopping transmissions to recover a data signal.

30. The wireless communication system of claim 28, wherein said receiver matches the feedback receiver shift register to the initial code word by:

constructing a plurality of relationships between transition matrices, a set of unknown initial states of the transmitter feedback shift register, and information represented by each transition;

deriving a plurality of linear equations from said relationships; and

solving said plurality of linear equations for said set of unknown initial states when the number of linear equations exceeds the number of unknown initial states of the transmitter feedback shift register, thereby yielding the initial states of said transmitter feedback shift register.

31. The wireless communication system of claim 30, wherein each of said transmissions is generated by said spread spectrum transmitter upon the occurrence of a predetermined set of code values in q designated stages of the transmitter feedback

shift register, said transmitter feedback shift register having n total stages, and wherein said receiver constructs said plurality of relationships by:

(a) assigning, to said q designated stages in the transmitter feedback shift register, said predetermined set of code values upon receipt of a first one of said transmissions;

(b) calculating a number of intervening clock pulses until the next consecutive transmission received at the receiver;

(c) obtaining a time-advanced transition matrix $A^p$ for the current received transmission, wherein an amount of time advancement is based upon a number of intervening clock pulses p between the occurrence of the first one of said transmissions and the occurrence of the current received transmission;

(d) deriving a linear equation according to the form $x \cdot A^p[q] = y$, wherein x represents a linear vector having a number of elements equal to the number of stages n in said transmitter feedback shift register, said linear vector comprising said predetermined set of code values at locations in said linear vector corresponding to the q designated stages in said transmitter feedback shift register and a set of n-q unknowns at locations in said linear vector corresponding to all other locations in said transmitter feedback shift register, wherein $A^p[q]$ represents a portion of a transition matrix A raised to a power equal to the number of intervening clock pulses p, said portion being those q columns in transition matrix $A^p$ which are associated with said q designated stages in the transmitter feedback shift register, and wherein y represents a

linear vector having a number of elements equal to the number of said q designated stages, said elements of y being assigned said predetermined set of code values; and

(e) repeating steps (b) through (d) until a sufficient number of said linear equations are derived to allow said set of unknown initial states to be solved.

32. The wireless communication system of claim 30, wherein said receiver further comprises a clock signal for incrementally advancing said receiver feedback shift register, and wherein the adjustment of said receiver feedback shift register is carried out by clocking said receiver feedback shift register at an accelerated rate until it matches the estimated state of said transmitter feedback shift register.

33. The wireless communication system of claim 30, wherein said receiver further comprises a modular feedback shift register configured to generate the same code sequence as the transmitter feedback shift register, and wherein the adjustment of said receiver feedback shift register is carried out by deriving a time-advanced feedback shift register code word from a plurality of vector dot products between the initial transmitter code word and a plurality of modular feedback shift register code words, said modular feedback shift register code words derived by:

initializing said modular feedback shift register with a code word of the form 100…0;

advancing the modular feedback shift register ahead by the number of clock intervals elapsed since the receipt of said first one of said consecutive transmissions,

thereby obtaining a first modular feedback shift register code word from the contents of said modular feedback shift register; and

incrementing the modular feedback shift register once for each additional bit needed for the transmitter feedback shift register, thereby obtaining successive modular feedback shift register code words from the contents of said modular feedback shift register at each increment.

34. The wireless communication system of claim 33, wherein said plurality of vector dot products are obtained by modulo-two combining one or more selected elements of the initial transmitter code word together to form each bit of the time-advanced feedback shift register code word, the one or more selected elements of the initial transmitter code word being combined together based upon the code values of said plurality of modular feedback shift register code words.

35. The wireless communication system of claim 28, wherein said transmitter is configured to transmit a second series of transmissions at a second predetermined frequency, said transmissions in said second series separated by one or more clock intervals pseudo-randomly determined according to said initial code word loaded into the transmitter feedback shift register, and wherein the wireless communication system further comprises a second receiver, comprising:

a second receiver feedback shift register;

means for measuring relative times of arrival between consecutive ones of said transmissions at said second predetermined frequency;

a second synchronizing circuit for determining said initial code word in the transmitter feedback shift register from the measured relative times of arrival between the consecutive transmissions at said second predetermined frequency, and for matching said receiver feedback shift register to the initial code word, adjusted by an amount of time since receiving the first one of said consecutive transmissions at said second predetermined frequency.

36. The wireless communication system of claim 28, wherein each of said transmissions from said spread spectrum transmitter comprises a spread spectrum code, and wherein said receiver comprises a correlator for detecting each of said transmissions, said correlator outputting a correlation pulse when each transmission is received to indicate the arrival of the transmission.

37. In a frequency hopping spread spectrum communication system, wherein a frequency hopping transmitter transmits in a pseudo-random manner across a plurality of frequencies including a key frequency, the transmissions over said key frequency being separated by one or more clock intervals pseudo-randomly determined according to an initial code word loaded into a transmitter feedback shift register, a receiver, comprising:

a receiver feedback shift register;

a receiving circuit tuned to said key frequency for detecting the transmissions over said key frequency;

a clocking circuit for measuring relative times of arrival between consecutive ones of said transmissions detected by said receiving circuit; and

a synchronizing circuit for determining said initial code word in the transmitter feedback shift register from the measured relative times of arrival between the consecutive transmissions, and matching said receiver feedback shift register to the initial code word, adjusted by an amount of time since receiving the first one of said consecutive transmissions.

38. The receiver of claim 27, wherein said synchronizing circuit matches the feedback receiver shift register to the initial code word by:

constructing a plurality of relationships between transition matrices, a set of unknown initial states of the transmitter feedback shift register, and information represented by each transition;

deriving a plurality of linear equations from said relationships; and

solving said plurality of linear equations for said set of unknown initial states when the number of linear equations exceeds the number of unknown initial states of the transmitter feedback shift register, thereby yielding the initial states of said transmitter feedback shift register.

39. The receiver claim 37, wherein each of said transmissions is generated by said frequency hopping transmitter upon the occurrence of a predetermined set of code values in q designated stages of the transmitter feedback shift register, said transmitter

feedback shift register having n total stages, and wherein said synchronizing circuit constructs said plurality of relationships by:

(a) assigning, to said q designated stages in the transmitter feedback shift register, said predetermined set of code values upon receipt of a first one of said transmissions;

(b) calculating a number of intervening clock pulses until the next consecutive transmission received at the receiver;

(c) obtaining a time-advanced transition matrix $A^p$ for the current received transmission, wherein an amount of time advancement is based upon a number of intervening clock pulses p between the occurrence of the first one of said transmissions and the occurrence of the current received transmission;

(d) deriving a linear equation according to the form $x \cdot A^p[q] = y$, wherein x represents a linear vector having a number of elements equal to the number of stages n in said transmitter feedback shift register, said linear vector comprising said predetermined set of code values at locations in said linear vector corresponding to the q designated stages in said transmitter feedback shift register and a set of n-q unknowns at locations in said linear vector corresponding to all other locations in said transmitter feedback shift register, wherein $A^p[q]$ represents a portion of a transition matrix A raised to a power equal to the number of intervening clock pulses p, said portion being those q columns in transition matrix $A^p$ which are associated with said q designated stages in the transmitter feedback shift register, and wherein y represents a

linear vector having a number of elements equal to the number of said q designated stages, said elements of y being assigned said predetermined set of code values; and

(e) repeating steps (b) through (d) until a sufficient number of said linear equations are derived to allow said set of unknown initial states to be solved.

40. A wireless communication system, comprising:

a spread spectrum transmitter configured to transmit a series of frequency-hopped transmissions over a plurality of frequencies including one or more key frequencies, the transmissions on a key frequency separated by one or more clock intervals pseudo-randomly determined according to an initial code word loaded into a transmitter feedback shift register; and

a plurality of receivers each attuned to a designated key frequency, each of said receivers comprising

a receiver feedback shift register;

means for measuring relative times of arrival between consecutive ones of said transmissions on the receiver's designated key frequency;

a synchronizing circuit for determining said initial code word in the transmitter feedback shift register from the measured relative times of arrival between the consecutive transmissions on the receiver's designated key frequency, and matching said receiver feedback shift register to the initial code word, adjusted by an amount of time since receiving the first one of said consecutive transmissions on the receiver's designated key frequency.

41. The wireless communication system of claim 40, wherein each of said receivers matches the feedback receiver shift register to the initial code word by:

constructing a plurality of relationships between transition matrices, a set of unknown initial states of the transmitter feedback shift register, and information represented by each transition on the receiver's designated key frequency;

deriving a plurality of linear equations from said relationships; and

solving said plurality of linear equations for said set of unknown initial states when the number of linear equations exceeds the number of unknown initial states of the transmitter feedback shift register, thereby yielding the initial states of said transmitter feedback shift register.

42. The wireless communication system of claim 41, wherein each of the transmissions on a particular key frequency is generated upon the occurrence of a predetermined set of code values in q designated stages of the transmitter feedback shift register, said transmitter feedback shift register having n total stages, and wherein each receiver constructs said plurality of relationships by:

(a) assigning, to said q designated stages in the transmitter feedback shift register, said predetermined set of code values upon receipt of a first one of said transmissions on the receiver's designated key frequency;

(b) calculating a number of intervening clock pulses until the next consecutive transmission on the receiver's designated key frequency that is received at the receiver;

(c) obtaining a time-advanced transition matrix $A^p$ for the current received transmission on the receiver's designated key frequency, wherein an amount of time

advancement is based upon a number of intervening clock pulses p between the occurrence of the first one of said transmissions on the receiver's designated key frequency and the occurrence of the current received transmission on the receiver's designated key frequency;

(d) deriving a linear equation according to the form $x \cdot A^p[q] = y$, wherein x represents a linear vector having a number of elements equal to the number of stages n in said transmitter feedback shift register, said linear vector comprising said predetermined set of code values at locations in said linear vector corresponding to the q designated stages in said transmitter feedback shift register and a set of n-q unknowns at locations in said linear vector corresponding to all other locations in said transmitter feedback shift register, wherein $A^p[q]$ represents a portion of a transition matrix A raised to a power equal to the number of intervening clock pulses p, said portion being those q columns in transition matrix $A^p$ which are associated with said q designated stages in the transmitter feedback shift register, and wherein y represents a linear vector having a number of elements equal to the number of said q designated stages, said elements of y being assigned said predetermined set of code values; and

(e) repeating steps (b) through (d) until a sufficient number of said linear equations are derived to allow said set of unknown initial states to be solved.

43. A method for synchronizing communication, comprising the steps of:

transmitting, from a transmitter, a signal having an observable parameter which is pseudo-randomly varied;

receiving said signal at a receiver;

measuring relative times between recurrences of a selected value of said observable parameter being pseudo-randomly varied;

determining an initial state of said transmitter based upon said measured relative times; and

synchronizing said receiver to an estimated current state of said transmitter using said determined initial state as a starting reference.